

## Complete Summary

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### GUIDELINE TITLE

Diagnosis and treatment of chest pain and acute coronary syndrome (ACS).

### BIBLIOGRAPHIC SOURCE(S)

Institute for Clinical Systems Improvement (ICSI). Diagnosis and treatment of chest pain and acute coronary syndrome (ACS). Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2004 Nov. 79 p. [144 references]

### GUIDELINE STATUS

This is the current release of the guideline.

### \*\* REGULATORY ALERT \*\*

#### FDA WARNING/REGULATORY ALERT

Note from the National Guideline Clearinghouse: This guideline references a drug(s) for which important revised regulatory information has been released.

On April 7, 2005, after concluding that the overall risk versus benefit profile is unfavorable, the FDA requested that Pfizer, Inc voluntarily withdraw Bextra (valdecoxib) from the market. The FDA also asked manufacturers of all marketed prescription nonsteroidal anti-inflammatory drugs (NSAIDs), including Celebrex (celecoxib), a COX-2 selective NSAID, to revise the labeling (package insert) for their products to include a boxed warning and a Medication Guide. Finally, FDA asked manufacturers of non-prescription (over the counter [OTC]) NSAIDs to revise their labeling to include more specific information about the potential gastrointestinal (GI) and cardiovascular (CV) risks, and information to assist consumers in the safe use of the drug. See the [FDA Web site](#) for more information.

### COMPLETE SUMMARY CONTENT

\*\* REGULATORY ALERT \*\*

SCOPE

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EVIDENCE SUPPORTING THE RECOMMENDATIONS

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INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT

CATEGORIES  
IDENTIFYING INFORMATION AND AVAILABILITY

SCOPE

DISEASE/CONDITION(S)

- Typical angina
- Atypical angina
- Nonanginal chest pain
- Acute myocardial infarction (AMI) and AMI complications including
  - Arrhythmic complications such as
    - Atrioventricular blocks
    - Bundle branch blocks
    - Premature ventricular contractions
    - Ventricular tachycardia
    - Accelerated idioventricular rhythm
    - Supraventricular arrhythmias
  - Ischemic complications, such as postinfarction angina
  - Mechanical complications, such as
    - Papillary muscle dysfunction
    - Papillary muscle rupture with mitral regurgitation
    - Ventricular septal rupture
    - Myocardial rupture
    - Right ventricular infarction
    - Pericarditis and tamponade
    - Left ventricular dysfunction
    - Congestive heart failure
- Acute coronary syndrome (ACS)
- Chest pain not related to coronary artery disease (CAD), but indicative of other serious diagnosis including
  - Aortic dissection or symptomatic aneurysm
  - Pulmonary embolus
  - Pneumothorax
  - Pericardial disease and tamponade

GUIDELINE CATEGORY

Diagnosis  
Evaluation  
Management  
Rehabilitation  
Risk Assessment  
Screening  
Treatment

CLINICAL SPECIALTY

Cardiology  
Emergency Medicine  
Family Practice

Internal Medicine  
Surgery

## INTENDED USERS

Advanced Practice Nurses  
Allied Health Personnel  
Emergency Medical Technicians/Paramedics  
Health Care Providers  
Health Plans  
Hospitals  
Managed Care Organizations  
Nurses  
Physician Assistants  
Physicians

## GUIDELINE OBJECTIVE(S)

- To increase the success of emergency intervention for patients with high-risk chest pain
- To improve the diagnostic value of stress tests through their appropriate use in patients with chest pain symptoms
- To minimize the delay in administering thrombolytics or angioplasty to patients with acute myocardial infarction (AMI)
- To increase the timely initiation of treatment to reduce post-infarction mortality in patients with AMI
- To increase the use of risk stratifying procedures in patients with AMI
- To increase the percentage of patients with acute MI, who have used tobacco products within the past year, who receive tobacco use assessment and cessation counseling and treatment within 24 hours of admission
- To increase the percentage of patients with acute MI using appropriate cardiac rehabilitation post-discharge
- To increase the percentage of patients with AMI whose course of treatment has followed the recommended critical pathway.

## TARGET POPULATION

Adults greater than age 18 years presenting with past or present symptoms of chest pain, discomfort and/or indications of acute coronary syndrome (ACS)

## INTERVENTIONS AND PRACTICES CONSIDERED

Screening/Evaluation/Diagnosis/Risk Assessment

1. Initial evaluation by triage
2. Medical history, physical examination, and risk assessment
3. Clinic evaluation depending on symptoms and risk factors
4. Vital signs assessment
5. Electrocardiogram (ECG)
6. Diagnostic coronary angiography
7. Treadmill stress test

8. Computed tomography (CT) angiogram, echocardiogram/transesophageal echocardiography (Echo/TEE), magnetic resonance imaging (MRI), arterial blood gases, chest x-ray if indicated

#### Management/Treatment/Rehabilitation

1. Emergency interventions including ambulance transport to Emergency Department, immediate assessment with cardiac monitoring, initial management according to the American Heart Association Advanced Cardiac Support guideline
2. Early therapy including aspirin (ASA), heparin/low-molecular weight heparin (LMWH), beta-blockers (esmolol) in eligible patients, nitroglycerin, glycoprotein IIb-IIIa inhibitors (Tirofiban HCL, abciximab, Eptifibatide)
3. Percutaneous coronary intervention (PCI) or coronary artery bypass graft (CABG) if indicated
4. Thrombolytics including tissue plasminogen activator (tPA) TNK, rPA
5. Treatment of acute myocardial infarction (AMI) complications
6. Phase 1 cardiac rehabilitation including ASA, clopidogrel, beta-blockers, angiotensin-converting enzyme (ACE) inhibitors, calcium channel blockers, oral nitrates, LMWH, warfarin, statins, tobacco cessation, glycemic control, healthy diet, and manageable exercises
7. Phase 2 cardiac rehabilitation (outpatient management) including medically supervised exercise with ECG monitoring, health education, and risk factor modifications
8. Phase 3 and 4 cardiac rehabilitation (outpatient non-monitored) including exercise prescription, risk factor modification, and psychosocial evaluation and counseling
9. Follow-up

#### MAJOR OUTCOMES CONSIDERED

- Diagnostic value of tests
- Prognostic value of risk assessment interventions
- Effectiveness of secondary prevention, treatment, and rehabilitation interventions on reducing mortality and morbidity rates
- Positive predictive value of new ST elevation

### METHODOLOGY

#### METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

#### DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

Not stated

#### NUMBER OF SOURCE DOCUMENTS

Not stated

## METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Not stated

## RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not applicable

## METHODS USED TO ANALYZE THE EVIDENCE

Review of Published Meta-Analyses  
Systematic Review

## DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

## METHODS USED TO FORMULATE THE RECOMMENDATIONS

Not stated

## RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

## COST ANALYSIS

The guideline developers reviewed published cost analyses.

## METHOD OF GUIDELINE VALIDATION

Clinical Validation-Pilot Testing  
Internal Peer Review

## DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Institute Partners: System-Wide Review

The guideline draft, discussion, and measurement specification documents undergo thorough review. Written comments are solicited from clinical, measurement, and management experts from within the member medical groups during an eight-week period of "Critical Review."

Each of the Institute's participating medical groups determines its own process for distributing the guideline and obtaining feedback. Clinicians are asked to suggest modifications based on their understanding of the clinical literature coupled with their clinical expertise. Representatives from all departments involved in implementation and measurement review the guideline to determine its operational impact. Measurement specifications for selected measures are

developed by the Institute for Clinical Systems Improvement (ICSI) in collaboration with participating medical groups following general implementation of the guideline. The specifications suggest approaches to operationalizing the measure.

#### Guideline Work Group: Second Draft

Following the completion of the "Critical Review" period, the guideline work group meets 1 to 2 times to review the input received. The original guideline is revised as necessary, and a written response is prepared to address each of the suggestions received from medical groups. Two members of the Cardiovascular Steering Committee carefully review the Critical Review input, the work group responses, and the revised draft of the guideline. They report to the entire committee their assessment of two questions: (1) Have the concerns of the medical groups been adequately addressed? (2) Are the medical groups willing and able to implement the guideline? The committee then either approves the guideline for pilot testing as submitted or negotiates changes with the work group representative present at the meeting.

#### Pilot Test

Medical groups introduce the guideline at pilot sites, providing training to the clinical staff and incorporating it into the organization's scheduling, computer, and other practice systems. Evaluation and assessment occur throughout the pilot test phase, which usually lasts for three months. Comments and suggestions are solicited in the same manner as used during the "Critical Review" phase.

The guideline work group meets to review the pilot sites' experiences and makes the necessary revisions to the guideline, and the Cardiovascular Steering Committee reviews the revised guideline and approves it for implementation.

## RECOMMENDATIONS

### MAJOR RECOMMENDATIONS

The recommendations for diagnosis and treatment of chest pain and acute coronary syndrome (ACS) are presented in the form of 7 algorithms with 123 components, accompanied by detailed annotations. Algorithms are provided for: [Chest Pain Screening](#); [Emergency Intervention](#); [ST-Segment Elevation Myocardial Infarction \(STEMI\)](#); [Acute Myocardial Infarction \(AMI\) Complications](#); [Special Work-Up](#); [Non-Cardiac Causes](#); and [Clinic Evaluation](#). Clinical highlights and selected annotations (numbered to correspond with the algorithm) follow.

Class of evidence (A-D, M, R, X) definitions are provided at the end of the "Major Recommendations" field.

#### Clinical Highlights

1. On initial contact with the health care system, high-risk patients need to be identified quickly and referred to an Emergency Room (ER) via the 9-1-1 system. (Annotations #1-7).

2. Patients whose chest pain symptoms are suggestive of serious illness need immediate assessment in a monitored area of the ER and early therapy to include an intravenous (IV), oxygen (O<sub>2</sub>), and an aspirin. (Annotation #17)
3. Triage and management of patients with chest pain and unstable angina must be based on a validated risk assessment system (i.e., American College of Cardiology/American Heart Association [ACC/AHA] criteria). (Annotation #24)
4. Patients with high-risk features need to be identified quickly and treatment instituted in a timely fashion (Annotations #24-28)
5. Patients with low-risk symptoms should be evaluated as outpatients in a timely fashion. (Annotations #24, 33, 34)
6. Treadmill test results should be reported using the Duke treadmill score, based on the Bruce protocol (Annotations #94-100, 104, 108, 112).
7. Thrombolysis should be instituted within 30-60 minutes of arrival, or angiogram/primary percutaneous coronary intervention (PCI) should be performed within 90 minutes of arrival with a target of less than 60 minutes. (Annotations #40, 42)
8. Use of medication: aspirin (ASA) or ASA and clopidogrel (Plavix®) at admission, beta-blockers whenever possible and/or angiotensin-converting enzyme (ACE) inhibitors at 24 hours if stable, nitrates (when indicated), and statins whenever possible. (Annotations #45 and 62)
9. Recommend appropriate use of cardiac rehabilitation post-discharge. (Annotations #60 and 61)

### Chest Pain Screening Algorithm Annotations

1. Initial Contact with Complaint of "Chest Pain/Discomfort" in Person or Via Telephone

Initial presentation may be in person or on the phone, etc.

Definitions:

Chest: Upper abdomen, chest, upper back, throat, jaw, shoulders, upper arms.

Pain: "Discomfort" or other abnormal sensation such "gas," "indigestion," "fullness," "pressure," "tightness," or "heaviness."

Evidence supporting this recommendation is of class: R

2. Initial Evaluation by Triage Indicates Elevated Risk?

The purpose of the initial chest pain screen is to route most inclusively all but those with negligible or no risk for cardiovascular compromise/death to immediate medical triage. This applies to initial contact with a receptionist or other non-medical personnel. It is important to systematically train personnel to recognize chest pain risk markers.

If any of the following are true, the patient should be directed to medical personnel:

- Patient is having pain now
- Interviewer senses the patient is in distress
- The onset of symptoms was within the past 8 weeks prior to call
- Pain was at least moderate
- Patient is having other symptoms of ill health
- Patient requests an immediate opportunity to discuss with medical personnel

Instruct the appropriate personnel in conducting the initial screen.

Evidence supporting this recommendation is of class: D

#### 4. Brief Screening History by Medical Personnel

Angina, typical angina, atypical angina, atypical chest pain, and non-cardiac chest pain are not consistently defined and used in medical practice. Sometimes they are used to describe a symptom complex; at other times they are used to describe an etiology. For the purposes of this guideline, the following definitions will be used to categorize the patient's chest pain or discomfort as a symptom complex and not an etiology:

Typical angina - pain or discomfort that is 1) substernal, 2) provoked by exercise and/or emotion, and 3) relieved by rest and/or nitroglycerine.

Atypical angina - pain or discomfort that has two of the three features listed for typical angina.

Nonanginal chest pain - pain or discomfort that has one or none of the three features listed for typical angina.

It should be emphasized that patients with non-anginal chest pain may still be at risk for acute MI or acute coronary syndrome. Several serious illnesses are included in the differential diagnosis of chest pain. Assessment of these illnesses requires office or Emergency Department (ED) evaluation. The initial phone interview is limited to determining the timing and location of the initial office or ED evaluation.

The risk of immediate adverse outcome is a function of the time course of the chest pain. If the symptoms have been stable for more than 2 weeks, the risk of an immediate adverse outcome is low. The phone history should stress symptoms suggestive of life-threatening illnesses and the time course of the symptoms.

#### High-Risk Symptoms

Symptoms suggestive of a high risk of immediate adverse outcome include, but are not limited to:

- Severe or ongoing pain
- Pain lasting 20 minutes or more



- New pain at rest or with minimal activity
- Severe dyspnea
- Loss of consciousness

The interviewer may use his/her discretion with respect to the need to obtain further history for such symptoms or refer to a physician.

All patients with high-risk chest pain symptoms should be instructed on the proper use of 911.

The interviewer must use his or her judgment. This guideline focuses on serious complaints which the interviewer feels may signify a serious illness. Chest pain which is not high risk in the judgment of the interviewer (e.g., a young person with chest wall pain) may be evaluated in the office.

A suggested shingle outlining the necessary documentation for this encounter is available from Institute for Clinical Systems Improvement (ICSI).

Teach medical triage personnel to appropriately conduct the brief screening history.

Evidence supporting this recommendation is of class: R

#### 5. High-Risk Symptom(s) Present at Time of Call

Call 911

#### 6. High-Risk Symptom(s) Present Within Last 2 Days

Patients who have had high-risk symptom(s) within the previous two days are at the highest risk and should enter the 911 system. The interviewer may judge the need for ambulance transport and office or ED evaluation for patients who call hours or days after transient symptoms resolve.

#### 8. High-Risk Symptom(s) Present Between 3 Days and Last 2 Weeks

Patients who have had high-risk symptom(s) within the previous two weeks but not the previous two days may be safely evaluated in either a properly equipped office or the ED.

#### 10. High-Risk Symptom(s) Present Between 2 Weeks and 2 Months

High-risk symptom(s) within two months of the initial evaluation but not within two weeks identify a group of patients at lower risk for immediate adverse outcome. These patients can be evaluated in the office within three days.

#### 11. Clinic Evaluation Within 72 Hours

Patient education directed toward use of 911 and recognition of signs and symptoms of an advancing coronary event should occur at this point.

#### 12. High-Risk Symptom(s) Present More than 2 Months Ago

Patients who have been stable without high-risk symptoms for the previous two months can be seen as a routine appointment.

#### 13. Elective Clinic Evaluation (Within 2 Weeks)

Patient education directed toward use of 911 and recognition of signs and symptoms of an advancing coronary event should occur at this point.

#### 14. Clinic Evaluation Same Day

If the severity and/or duration of the chest pain symptoms cannot be determined in the phone interview, the patient should be seen on the same day in the office or the ED.

### Emergency Intervention Algorithm Annotations

#### 16. Ambulance Transport to Emergency Department

A patient complaining of chest pain suggestive of serious etiology should be transported via ambulance with Advanced Cardiac Life Support (ACLS) capabilities whether he/she is being transported from home or outpatient clinic to the ED.

Patients who are critically ill or unstable should be taken to a hospital capable of performing cardiac catheterization and cardiac surgery unless this would lead to excessive transport time. Plans for triage of a critically ill patient to a tertiary care institution should be part of every community hospital plan.

If a patient is seen in a clinic or physician's office complaining of chest pain suggesting a serious condition, the patient must be transported to the ED as soon as possible. Attempts should be made to stabilize the patient as well as possible prior to transport. The referring physician must call the receiving physician and send copies of all medical records pertaining to the current illness.

Evidence supporting this recommendation is of classes: B, R

#### 17. Immediate Assessment with Cardiac Monitoring

On arrival in the ED, a patient complaining of chest pain should immediately receive oxygen via nasal cannula, and a 324 mg loading dose of aspirin, preferably chewed (for patient palatability, use four 81 mg baby aspirin tablets); an immediate electrocardiogram (ECG) should be done and the physician called for as the patient is placed on a cardiac monitor. An IV should be started as soon as possible and cardiac markers drawn. Troponin I or T has been proven to be very sensitive and specific for myocardial injury as well

as predictive of short-term risk for myocardial infarction or death. Creatine kinase MB band (CKMB) should no longer be used as the primary marker for myocardial infarction, but can be useful in assessing the timing of the event. It may also be useful in patients with renal failure who also have an elevated troponin. Interpretation of an abnormal serum troponin (or CKMB) is dependent upon the clinical setting in which the myocardial injury occurred. A portable chest x-ray may be performed if indicated. The ED physician should also be called to the patient's bedside immediately.

On arrival, the physician should perform a brief initial assessment based on vitals, brief historical information, and physical examination. Institution of stabilizing therapy (including chewable aspirin for suspect anginal pain) prior to completing history or physical is appropriate and often necessary at this level.

Evidence supporting this recommendation is of classes: B, R

#### 18. Vital Signs Compromised?

In the critically ill patient whose vitals are compromised (i.e. cardiac arrest, tachyarrhythmias, severe bradycardia, shock or hypotension); the Advanced Cardiac Life Support guidelines developed by the American Heart Association should be followed.

#### 19. Initiate Advanced Cardiac Life Support (ACLS) Protocols

The American Heart Association Advanced Cardiac Life Support guideline provides the most recent protocols for initial management of patients whose vital signs are compromised.

#### 20. Symptoms Suggest Possibility of an Acute Coronary Syndrome Disease (ACS)?

The symptoms that suggest ACS are, in order of importance:

1. Chest pain description (See Annotation #4 above, "Brief Screening History by Medical Personnel")
2. History or evidence of ischemic heart disease
3. Age, gender, comorbidities (atypical presentation in female, elderly, and diabetic)
4. Presence of cardiac risk factors

The description of the patient's chest pain or discomfort is the most critical part of the history. Although multiple other features of the chest pain may be incorporated into an experienced clinician's judgment, the clinician should ultimately attempt to classify the patient as having typical angina, atypical angina, or nonanginal chest pain as described in Annotation #4, "Brief Screening History by Medical Personnel" of the Chest Pain Screening algorithm.

Evidence supporting this recommendation is of classes: C, M

## 21. Electrocardiogram (ECG) Positive for ST-Segment Elevation?

The recognition of coronary artery disease and evaluation of its severity cannot be adequately carried out without an electrocardiogram. The early performance of an electrocardiogram following arrival at the emergency department is therefore critical. When patients have new or presumably new ST elevation of greater than 1 mm in two contiguous leads, they should be considered to have acute myocardial infarction. Patients with new or presumably new left bundle branch block (LBBB) should be treated similarly to those with ST segment elevation. Although some patients with left bundle branch block will prove not to have acute myocardial infarction, thrombolytic therapy of patients with LBBB is nevertheless associated with a reduction in patient mortality.

Evidence supporting this recommendation is of classes: A, C, R

## 22. Early Therapy

Aspirin reduces mortality, reinfarction, and stroke. Although the incremental value of heparin/low-molecular weight heparin (LMWH) in conjunction with aspirin (ASA) and reperfusion therapy is controversial, it does appear to enhance patency, and was included in the GUSTO protocol. In eligible patients, beta-blockers reduce mortality, reinfarction, and stroke. Although long-acting nitrates (oral and intravenous) appeared to reduce mortality in trials that did not include thrombolysis, more recent studies that did include thrombolysis found no incremental benefit from nitrate therapy. Nitrate therapy is still appropriate for ischemic pain relief.

Evidence supporting this recommendation is of classes: A, C, M, R

## 24. Risk Assessment (ACC/AHA Criteria)

Low-risk patients may be safely evaluated as outpatients. These will include some patients with slight progression of their symptoms, which may reflect non-compliance with medications, increasing activity, emotional stress, or other exacerbating factors. Patients with a low likelihood of coronary artery disease (CAD) on the basis of chest pain description, age, gender and risk factor assessment, and patients at intermediate likelihood who have not had rest symptoms that are prolonged or accompanied by shortness of breath or other worrisome features, should also be considered stable.

For patients whose angina does not seem stable, it is important to use objective risk assessment criteria for purposes of triage (Critical Care Unit [CCU]), monitored bed or dismissal with follow-up). This guideline endorses the criteria published by the ACC/AHA in 2002 "ACC/AHA 2002 Guideline Update for the Management of Patients with Unstable Angina and Non-ST-segment Elevation Myocardial Infarction." These consist of a simple set of clinical variables to classify patients as high-intermediate- or low-risk of death of myocardial infarction (MI). The work group acknowledges that many other risk assessment criteria sets exist (e.g., TIMI), and recommends that medical groups and hospitals choose one that is validated and implement its use system wide.

Complete certainty of the etiology of a patient's chest pain can commonly not be attained in the ED. It is therefore vitally important to assess risk in order to safely and yet cost-effectively triage chest pain patients. Further, it is important to recognize the difference between risk assessment and likelihood assessment in that likelihood assessment merely serves to communicate just that, while risk assessments may be used as a tool for clinical management.

Evidence supporting this recommendation is of classes: B, C, R

## 25. High Risk

High-risk unstable angina patients require a high level of care with close monitoring and IV therapy, including heparin, beta-blockade, and nitroglycerin (NTG). This needs to be started in the ED setting. Hospitalization usually requires an Intensive Care Unit (ICU) setting or competent nursing in a monitored bed setting.

Glycoprotein (GP)IIb/IIIa inhibitors

Patients with high risk (as defined in Annotation #24 "Risk Assessment [ACC/AHA Criteria]"); benefit from receiving GP IIb-IIIa inhibitor (Tirofiban HCl, abciximab, or Eptifibatide) as part of initial treatment.

Early invasive strategy involves diagnostic catheterization within 24 to 48 hours, followed by PCI or coronary artery bypass graft (CABG) if warranted.

Contraindications to IIb-IIIa inhibitors include bleeding less than 6 weeks, intracranial hemorrhage (ever), recent stroke less than 2 years, uncontrolled hypertension greater than 200/100 mmHg, surgery less than 6 weeks, aortic dissection, acute pericarditis, platelets less than 100,000 mm<sup>3</sup>.

Evidence supporting this recommendation is of classes: A, M, R

## 26. Early Therapy

All patients should receive aspirin (chewable) as soon as possible and continued indefinitely. In those patients who are unable to take aspirin, clopidogrel should be considered in hospitalized patients. The benefits of beta-blockers, nitroglycerin and heparin are well established. There is data to support the use of LMWH as an alternative to intravenous heparin.

In high-risk patients, early administration of subcutaneous LMWH (enoxaparin 1mg/kg subcutaneous every 12 hours) or IV unfractionated heparin (UFH) (70 units/kg load then 12 to 15 units/kg/hr to achieve activated partial thromboplastin time [aPTT] levels of 1.5 to 2.5 times the control), with aspirin and/or clopidogrel is associated with a decrease in the incidence of AMI and ischemia.

LMWH, specifically enoxaparin, has been shown to have a moderate benefit over IV heparin in decreasing the rate of death, MI, and recurrent ischemia. A

meta-analysis of the 2 trials showed a statistically significant reduction by 20% in the rate of death and MI.

The use of LMWH should be used with caution in patients with renal insufficiency.

The recently completed SYNERGY study found increased adverse events in patients that were switched from unfractionated heparin to low-molecular weight heparin or vice-versa at the time of referral to tertiary care institutions. Therefore, the suggestion is that the patient be started and maintained on one drug or the other during transfer and treatment at referring and referral institutions.

Beta-blockers should be initiated early in the absence of any contraindications. In high-risk patients, they should be given initially IV then followed by the oral route with a goal target resting heart rate of 50-60 beats per minute (bpm). Patients with low to intermediate risk may start out with oral therapy. The duration of benefit is uncertain. A meta-analysis of double blinded randomized trials in patients with evolving MI showed a 13% reduction in risk progression to acute myocardial infarction (AMI). Other multiple randomized trials in CAD patients have shown a decrease in mortality and/or morbidity rates.

Beta-blockers should be used cautiously in patients with history of asthma, severe left ventricular (LV) dysfunction, hypotension, sinus bradycardia, heart block, or cardiogenic shock. Oral beta-blockers may be started later after the patient is stable or condition resolves. A short acting agent such as esmolol may be considered if physician is concerned about possible adverse effects.

Nitroglycerin should be given sublingually (0.4 mg every 5 minutes) to relieve ischemic symptoms. If symptoms are ongoing or recurrent despite the administration of IV beta-blockers, IV nitroglycerin can be initiated at 10mcg/min and titrated every 3 to 5 minutes by 10 mcg/min until symptom response is noted or blood pressure decreases to less than 110 mmHg in patients previously normotensive or by 25% in patients who were hypertensive on presentation, or to a maximum dose of 200 mcg/min. Patients can be converted to topical or oral nitrates once stabilized (no manifestations of ischemia and pain free for 12 to 24 hours).

ISIS-4 and GISSI-3 failed to show a benefit of nitroglycerin on reduction of mortality in acute myocardial infarction (AMI).

Nitroglycerin is contraindicated in patients who are hypotensive, have documented severe aortic stenosis, have hypertrophic cardiomyopathy, or who have received sildenafil, vardenafil, or tadalafil within the previous 24 hours or tadalafil in the previous 48 hours.

27. Admit

28. Perform Catheterization Within 24 to 48 Hours

Early invasive strategy involves diagnostic coronary angiography within 24 to 48 hours, followed by PCI or CABG if warranted. Other options include IIb-IIIa inhibitors when lab is not available (e.g., recurrent pain late at night), or there is an inability to transfer the patient (e.g., weather related delay).

Contraindications to IIb-IIIa inhibitors include bleeding less than 6 weeks, intracranial hemorrhage (ever), stroke less than 2 years, uncontrolled hypertension greater than 200/100 mm Hg, surgery less than 6 weeks, aortic dissection, acute pericarditis, platelets less than 100,000 mm<sup>3</sup> and dialysis dependent renal failure.

Evidence supporting this recommendation is of classes: A, C, M, R

#### 29. Intermediate Risk

A patient of intermediate risk unstable angina (as defined by the ACC/AHA Guideline) is by far the most common presentation to the emergency department. Approximately 50% of these patients will turn out to have an end point diagnosis other than ACS. It is, however, impossible to predict which patients truly have an ACS after the initial evaluation in the emergency department. As the short-term risk of a significant cardiac event is between 5 and 20% it is imperative to treat each patient according to protocol during the evaluation process. These patients should be considered as primary candidates for evaluation in a cardiac observation unit if available, or a critical pathway in a monitored bed setting.

#### 30. Early Therapy

See Annotation #26, "Early Therapy" above.

#### 31. Admit to Chest Pain Unit (CPU) or Monitored Bed

If the patient's risk assessment is not clearly in a high- or low-risk category, and the institution has an ED-based chest pain observation unit, admission to this unit would be appropriate. Otherwise, management using a critical pathway for unstable angina with a similar protocol on a monitored bed unit is recommended.

A CPU/critical pathway provides monitoring capabilities, a dedicated nurse, serial enzymes, and a post-observation stress test prior to final triage decision. Generally, after successful completion of the evaluation, patients can be classified as low-risk and safely followed up as outpatients in the next 1-3 days. In the case of a positive or indeterminate lab test, ECG or stress/imaging test, or if there is recurrent chest pain during the observation period, a patient should be considered high risk and managed accordingly.

It should be emphasized that a patient who requires repeated doses of NTG and/or IV NTG or paste, or requires beta-blockade for pain control should be considered high risk.

Refer to Annotation #24, "Risk Assessment (ACC/AHA Criteria)" above for more information on risk stratification.

Evidence supporting this recommendation is of class: R

### 32. Patient Has Positive: Markers? ECG Changes? Treadmill Stress Test? Unstable Dysrhythmias?

If a patient develops recurrent chest discomfort during the observation period the patient should be considered having failed the observation unit intervention and should be considered high risk and admitted to a monitored bed or an ICU setting. If the cardiac markers, troponin T or I and CKMB on the second blood draw are positive, or the patient develops new or dynamic ST-T wave changes, the patient should be considered high risk. If a patient develops an unstable dysrhythmia (i.e., ventricular tachycardia [VT] or multifocal premature ventricular contractions [PVC's] etc.), he/she should also be considered high risk and admitted.

Most patients in this category will have an uneventful observation period and should undergo an endpoint stress test. The choice of a treadmill exercise test utilizing the Bruce treadmill score should be preferred in all patients who can walk and have an interpretable ECG. Other patients should undergo a stress nuclear imaging or echocardiogram. If the patient is unable to walk, a pharmacologic stress test should be considered. Patients needing continued beta-blockade may be candidates for nuclear imaging instead of standard treadmill stress testing.

Evidence supporting this recommendation is of classes: A, C

### 33. Low Risk

The patients with a history of brief episodes of chest pain (less than 20 minutes) but suggestive of accelerating and/or class 3 or 4 angina should be considered low risk if indeed ECG can be obtained during the chest pain episodes. If, however, an ECG cannot be obtained during a chest pain episode or other atypical features are present, the patient may be managed as intermediate risk and be evaluated in a cardiac observation unit.

### 34. Discharge to Outpatient Management

If the diagnosis is low risk unstable angina, a follow-up appointment with cardiologist preferably, should be done. Otherwise, a follow-up with a primary care physician may also be appropriate. These appointments should occur within one to three days. If the chest pain is considered stable angina and non-anginal chest pain, an arrangement for follow-up with a primary care physician should be arranged in the near future. The primary care physician may want to follow the clinical evaluation algorithm provided within the original guideline document.

### 35. Non-Cardiovascular Chest Pain



In evaluating a patient with chest pain it is important to keep in mind the entire differential diagnosis, including non-cardiac causes. Missed or misdiagnosis may have serious implications, both in regards to medico-legal issues and resource utilization.

### 36. Chest Pain Not Related to CAD, but Indicative of Other Serious Diagnosis?

Aortic dissection, pulmonary embolus, expanding pneumothorax, pericarditis with impending tamponade, or serious gastrointestinal pathology are all potentially life threatening and may mimic closely presentations of an acute coronary syndrome. Further, the presence or absence of reproducible chest wall pain does not preclude the possibility of a more serious underlying cause.

## STEMI Algorithm Annotations

### 39. ST-Segment Elevation on ECG

About 40% of patients with AMI present with ST-segment elevation. They can be treated with thrombolytics or with emergency coronary angiography and percutaneous coronary intervention. Patients presenting with chest pain but no ST-segment elevation may be triaged to the telemetry unit if they are hemodynamically stable and pain-free.

### 40. Thrombolytics

#### Indications for Thrombolytics

- ST segment elevation of 1 mm or more in two or more contiguous leads OR
  - ST segment elevation of 2 mm or more in precordial leads OR
  - New or presumably new left bundle branch block (LBBB); ST segment depression of 2 mm or more in V<sub>1</sub>V<sub>2</sub> (true posterior infarction), AND
- Anginal chest pain between 30 minutes and 12 hours in duration that is unrelieved with NTG SL

#### Administration of Lytics

Options include full dose lytic of choice (tissue plasminogen activator [tPA], TNK, rPA), half-dose lytic (transfer arrangements with the receiving institution should be worked out in advance (this is a IIb indication per the 2004 ACC/AHA guidelines), or transfer for primary PCI.

Low patient weight has been identified as an ongoing risk factor for significant intracranial hemorrhage (ICH) when thrombolytics are administered. It is imperative to accurately estimate the weight of patients with acute myocardial infarction to determine the proper dose of thrombolytic to minimize the risk of ICH.

Single-bolus agents, such as tenecteplase (TNKase®) simplify administration, however patient weight remains important in calculating dose.

Refer to the original guideline document for additional information on Lytics administration.

Evidence supporting this recommendation is of classes: A, C, D, R

#### Contraindications to Thrombolytics

Refer to the "Contraindications" field for more information.

### 42. Emergency Coronary Angiography and Primary PCI

Primary PCI has been demonstrated to be more effective than thrombolysis in opening acutely occluded arteries in settings where it can be rapidly employed by experienced interventional cardiologists.

Time to open artery is critical to effective primary PCI. Current American College of Cardiology/American Heart Association guidelines suggest that institutions wishing to apply primary PCI for STEMI should achieve a median door-to-balloon time of 90 minutes or less. The ACC/AHA Consensus Panels have set a 60-minute median door-to-balloon time as the benchmark for top performing institutions.

Institutions that cannot meet the recommended treatment times should consider preferential use of intravenous thrombolytic therapy. These institutions should have a predetermined plan for treating patients who present with contraindication to thrombolytics.

Aspirin, heparin, nitrates and beta-blockers should be administered early to these patients, unless contraindicated.

Primary PCI may also play a role in the treatment of non-STEMI/refractory angina pectoris if angina symptoms fail to resolve within an hour of instituting aggressive anti-anginal therapy with aspirin, heparin, beta-blockers, and GP IIb-IIIa inhibitors; or serial EKG or echocardiogram suggest a large amount of myocardium at risk.

Evidence supporting this recommendation is of classes: C, R

### 43. PCI or Coronary Artery Bypass Graft (CABG)?

In high-risk patients with ACS/non-STEMI, an early invasive evaluation with mechanical revascularization (PCI or CAB) has been shown to improve outcomes.

Rescue angioplasty involves the use of PCI to restore coronary flow after thrombolysis has failed. Guidelines for time from arrival to balloon inflation are not established for this complex subset of patients, but rescue PCI should be accomplished within 90-120 minutes of thrombolytic failure if possible.

Thrombolytic failure may be evident by failure of ST-elevation to resolve within 30-60 minutes of thrombolytic therapy and usually includes persistent symptoms.

Facilitated PCI is the use of additional agents to pretreat the patient awaiting primary PCI. No strategy employing full- or reduced-dose thrombolytic (with or without a glycoprotein IIb/IIIa receptor inhibitor) has been approved for facilitated PCI. GPIIb/IIIa inhibitors should be considered in patients with symptoms refractory (persistent chest pain or ECG changes consistent with ischemia) to standard therapy. Otherwise these agents may be given at the time of angiography. Based on REPLACE-2 study, a reasonable alternative to heparin is to use bivalirudin for patients who will be undergoing percutaneous coronary interventions.

The recently completed SYNERGY study found increased adverse events in patients that were switched from unfractionated heparin to low-molecular-weight heparin or vice-versa at the time of referral to tertiary care institutions. Therefore, the suggestion is that the patient be started and maintained on one drug or the other during transfer and treatment at referring and referral institutions.

Current ACC guidelines recommend treating the culprit vessel when feasible and deferring surgical or PCI-based revascularization of other vessels until the patient has stabilized and the clinically most appropriate strategy determined.

Evidence supporting this recommendation is of classes: A, D, M

#### 45. CCU Admission

Patients who present with acute ST-segment elevation, hemodynamic instability, or both should be admitted to the CCU. Early use of adjunctive medications can be reconsidered. (See Emergency Interventions Algorithm Annotations #17 to 27 above.)

#### 46. CCU Care: Chronic Adjunctive Medications/Phase I Cardiac Rehabilitation

A protocol should be in place to guide routine orders for continuous monitoring, oxygen delivery, IV therapy, activity, laboratory and diagnostic tests, diet, and medications.

Use of the following medications should be considered:

- ASA\* should be continued as the clinical situation warrants. ASA has been shown to reduce reinfarction and mortality long-term, and should be continued whenever possible.
- Clopidogrel\*\* ASA (dose should be 81 mg when given with clopidogrel) with clopidogrel in intermediate and high-risk ACS patients is beneficial. Anyone with an allergy to aspirin or NSAIDs should receive a bolus dose of clopidogrel (300 mg) with maintenance dosing indefinitely. For patients who present with unstable angina or non-ST

elevation MI who are not at high risk for bleeding, clopidogrel should be continued for 9-12 months. For patients undergoing a non-coated stent, clopidogrel should be continued for at least 1 month. In patients who receive a sirolimus eluting stent, clopidogrel should be continued for at least 3 months, and at least 6 months for a paclitaxel eluting stent. In patients who have undergone brachytherapy, clopidogrel should be continued for 12 months. ASA plus clopidogrel or clopidogrel alone can also be used with patients who have stents. If clopidogrel is given and coronary artery bypass surgery planned, clopidogrel should be held for 5 days prior to surgery due to increased risk of perioperative bleeding.

- Beta-Blockers\* Beta-blockers reduce mortality, readmission and reinfarction for both CAD and CHF. They should be instituted and/or continued whenever possible. Intravenous esmolol should be considered if a clinician is concerned about potential adverse effects of beta-blockers. Patients who prove intolerant of a beta-blocker after a large infarction should be reconsidered for beta-blocker therapy after discharge.
- ACE inhibitors\* ACE inhibitors are indicated (in addition to beta-blockers, when possible) for most patients following acute MI to reduce mortality and morbidity associated with large infarcts with significant LV dysfunction, reduce adverse ventricular remodeling which may result in further reduction in EF, and for potential reduction of future MI and stroke.

\*Shown in large clinical trials to reduce infarction mortality in all MIs

\*\*Shown in large clinical trials to reduce infarction mortality in non-STEMIs

Evidence supporting this recommendation is of class: A

- Calcium channel blockers may be useful for control of blood pressure and ischemic pain when beta-blockers are contraindicated but should be avoided in patients with decreased LV function or heart failure. The short-acting dihydropyridine calcium channel blockers (e.g., nifedipine) may be associated with increased risk and should be avoided in acute ischemic syndromes.
- Oral nitrates may benefit selected patients with postinfarction angina or CHF.
- Low-molecular-weight heparin has been shown to be superior to unfractionated heparin in patients without ST-segment elevation and can preferentially be used in subcutaneous dosing (e.g., enoxaparin sodium [Lovenox®], 1 mg/kg every 12 hours). Heparin may be continued for 2-4 days or maintained until conversion to warfarin is completed. If unfractionated heparin is used, the dose should be regulated to maintain an activated partial thromboplastin time of 50-75 seconds.
- Warfarin therapy may be initiated in certain clinical situations (e.g., postinfarction CHF or anterior MI with high risk of LV thrombus) as soon as clinical stability is achieved and invasive diagnostic studies are completed. The usual target international normalized ratio is 2.0-3.0.

- Oral antiarrhythmics are not recommended, especially when LV function is reduced. Flecainide acetate (Tambocor®) and sotalol hydrochloride (Betapace®) should be avoided in patients with significant structural heart disease unless clearly indicated on the basis of electrophysiologic study for the suppression of life-threatening ventricular arrhythmias. Beta-blockers are the current drug of choice when tolerated. Routine use of amiodarone hydrochloride (Cordarone®) in post-MI patients with nonsustained ventricular ectopy has not been shown to reduce mortality.

Evidence supporting this recommendation is of classes: A, M

- Statins. The large majority of patients who have an acute MI have high serum lipid levels. Lipid treatment, including administration of statins, should be addressed as soon as possible. A patient's lipid status should be determined within the first 24 hours. If the LDL level is greater than 70 mg/dL, the patient should be started on a statin within the first 24 hours of the onset of MI.
- Tobacco cessation should be addressed as soon as possible for patients who smoke or use tobacco products. Appropriate treatment may include administration of bupropion and/or a nicotine patch in the hospital.
- Glycemic control. Tight control of blood glucose in patients with diabetes is recommended.

Medication tables and dosing protocols are attached in Annotation Appendix B, "AMI Acute Medications and Adjunctive Therapy."

### Phase 1 Cardiac Rehabilitation

With shortened length of stay, teachable moments may be limited. As a result, timely initiation of education on lifestyle modification is crucial. Phase 1 cardiac rehabilitation should begin as soon as the patient is stable and pain-free. Goals are to minimize harmful effects of immobilization, assess the hemodynamic response to exercise, manage the psychosocial issues of cardiac disease, and educate the patient and family about lifestyle modification including:

- Tobacco cessation
- Dietary instruction including a heart healthy diet
- Manageable exercise regimen should be explained

### 47. Complications?

Arrhythmic complications include sinus bradycardia, Möbitz I block (Wenkebach), Möbitz II block, complete heart block or asystole, premature ventricular contractions (PVCs), ventricular tachycardia, ventricular fibrillation, accelerated idioventricular rhythm, and supraventricular arrhythmias (atrial flutter, atrial fibrillation, and supraventricular tachycardia). Ischemic complications include postinfarction angina. Mechanical complications include papillary muscle dysfunction, rupture with significant mitral regurgitation, ventricular septal rupture, myocardial rupture, right

ventricular infarction, pericarditis with or without tamponade, LV dysfunction, and aneurysm formation.

Evidence supporting this recommendation is of classes: C, M

#### 49. Transfer to Post-CCU Care

Patients should be transferred from the CCU to the telemetry or step-down unit when they are pain-free, hemodynamically stable, and meet the institution's protocol for admission to the telemetry unit (usually 12 to 24 hours after MI). Discontinuation of cardiac monitoring should be considered for patients who attain electrical stability (usually within 3 days of infarction).

#### 51. Risk Stratification

Assessment of ejection fraction is important in predicting prognosis. Most patients should undergo echocardiography or other assessment of LV ejection fraction. A treadmill test is useful for assessing functional reserve but is not useful for predicting recurrence of acute MI. If ST-segment depression or angina is present early in treatment, angiography should be considered. If the patient is unable to exercise, pharmacologic stress testing should be considered, and if the ECG is uninterpretable, stress imaging (nuclear or echocardiographic) should be considered.

Evidence supporting this recommendation is of class: R

#### 52. Patient at Increased Risk and Needs Intervention?

Patients who are at increased risk for adverse prognosis after acute MI and who are also candidates for short-term intervention include those with a large amount of myocardial necrosis (ejection fraction less than 40%), residual ischemia (angina during hospitalization or exercise testing), electrical instability (greater than 10 PVC/hr), left main or three-vessel CAD, limited exercise tolerance, or rales in more than one-third of lung fields.

The following factors increase long-term risk:

- 70 years of age or older
- previous infarction
- anterior-wall MI
- hypotension and sinus tachycardia
- diabetes
- female sex
- continued smoking
- atrial fibrillation
- heart failure

Evidence supporting this recommendation is of class: B

#### 53. Cardiac catheterization

Angiography should be performed in patients at increased risk as defined in Emergency Intervention Algorithm Annotation #24, "Risk Assessment (ACC/AHA Criteria)."

Recent trials (collectively FRISC II and TACTICS-TIMI 18) suggest an early aggressive/invasive approach (early diagnostic coronary angiography and appropriate PCI or CABG) within 48 hours of presentation, in non-ST ACS (with ST segment deviation, elevated cardiac markers or TIMI Risk Score greater than 3), significantly reduces the risk of major cardiac events. A TIMI Risk Score Calculator can be downloaded at [www.timi.tv/riskscore/risk\\_home.htm](http://www.timi.tv/riskscore/risk_home.htm). However, the majority of non-STEMI patients should undergo coronary angiography.

#### 54. Revascularization Candidate?

CABG should be considered in patients with left main, three-vessel, or two-vessel disease with left anterior descending coronary artery involvement and demonstration of ischemia. Pharmacologic or stress test imaging may be helpful if myocardial viability is uncertain and revascularization is considered.

PCI should be considered in patients with acceptable anatomy in whom its prognostic effect has been most clearly demonstrated: significant residual ischemia, CABG candidacy, and failure of maximal medical therapy (two of three medications) to control angina or contraindications to medications.

#### 57. Continue Adjunctive Medications

See STEMI Algorithm Annotation #46, "CCU Care: Chronic Adjunctive Medications/Phase I Cardiac Rehabilitation" above.

#### 58. Secondary Prevention and Risk Factor Modification

Modification of risk factors (e.g., high lipid levels, hypertension, smoking) significantly reduces subsequent cardiovascular mortality. Risk factor counseling must be documented in the medical record in a consistent manner. A "care plan" or "critical pathway" approach with flow sheets may be used. Ongoing patient monitoring and feedback are important. Adjunctive therapy (ASA or ASA and clopidogrel, beta-blockers, warfarin for large anterior infarctions, ACE inhibitors and statins should be continued.

Evidence supporting this recommendation is of classes: A, D, M, R

#### 59. Discharge

Complete and document the following before discharge:

- Patient education that includes discharge diagnosis, medical regimen, lifestyle modification issues, and functional limitation (including resumption of sexual activity and driving.)
- Scheduling of a follow-up appointment with the primary care physician.

- Targeting a return-to-work date. Patients with sedentary jobs often return to work in 2-3 weeks. More physically demanding jobs often can be resumed in 4-6 weeks unless significant ischemia is present.

Patients are commonly discharged in less than 3 days following successful primary PCI with evidence of complete or near complete salvage of threatened myocardium. Though patients should avoid strenuous exertion for several weeks during the stent healing phase, many such patients may return to sedentary or only moderately active work activities within days of discharge.

Information on discharge medication is attached in Annotation Appendix C, "Medications to Consider on Discharge" of the original guideline document.

Evidence supporting this recommendation is of class: A

#### 60. ECG-Monitored Exercise Needed?

Most patients do not require an ECG-monitored, hospital-based (phase 2; outpatient) exercise program, but those with any of the following characteristics may be at increased risk for infarction or sudden death with unmonitored exercise and should be considered for a phase 2 program, usually lasting 1-4 weeks: very low functional capacity (less than 4 METs), severely depressed ventricular function (ejection fraction less than or equal to 35%), complex resting ventricular arrhythmias, exercise-induced hypotension, exertional angina or significant silent ischemia, or inability to initiate a self-directed exercise program.

For certain patients, referral to a phase 2 program may facilitate earlier hospital discharge by providing emotional support in the outpatient hospital setting. The decision to refer a patient to a phase 2 program should be made on a case-by-case basis. The patient's current exercise capacity and the demands of expected occupational and recreational activities should be considered.

Evidence supporting this recommendation is of classes: A, M, R

#### 61. Phase 2 Cardiac Rehabilitation/Outpatient Management

Phase 2 (outpatient monitored) programs, if indicated, consist of medically supervised exercise with continuous ECG monitoring attended by trained personnel who have emergency equipment. Most phase 2 programs are hospital-based. Health education and risk factor modifications need to be included in these programs.

Evidence supporting this recommendation is of classes: A, R

#### 62. Phase 3 Cardiac Rehabilitation

Phase 3 programs are outpatient non-monitored. At hospital discharge, patients should receive an exercise prescription based on tolerance to in-



hospital activity, risk factors, and stress testing (if done). Up to 10% of patients with MI have significant depression; counseling and stress reduction may be helpful, but if symptoms persist for more than 4 weeks, referral to a psychiatric specialist may be needed. Tricyclic antidepressants are best avoided.

Phase 3 cardiac rehabilitation emphasizes exercise training and activity prescription, risk factor modification, and psychosocial evaluation and counseling in an attempt to lower morbidity and mortality following MI. The following should be considered when writing an exercise prescription:

- Exercise treatment. Education about the signs and symptoms of overexertion, angina, and cardiopulmonary distress is important.
- Type of exercise. Aerobic exercise is emphasized. It includes any activity that preferentially uses large muscle groups and can be maintained for a prolonged period (e.g., walking). Pure isometric exercise should be minimized because it may result in LV decompensation in patients with poor LV function.
- Intensity of exercise. This should be based on an exercise tolerance test or the MET level at discharge from phase 2 rehabilitation. In patients with an angina threshold of 2-3 METs, exercise training may not be appropriate.
- Target heart rate. This should be determined from an exercise test or a monitored exercise session. If this is not feasible, target heart rate can be calculated as follows:

$$220 - \text{age} = \text{maximum heart rate}$$

$$65\% \times \text{maximum heart rate} = \text{target heart rate}$$

This applies to patients who are not taking a beta-blocker and who have been shown to tolerate the heart rate without ischemia.

- Monitoring rate of perceived exertion. The Borg scale of perceived exertion is a useful tool in guiding exercise programs. It is used in conjunction with the target heart rate when instructing patients on exercise tolerance. Target rates are usually between 11 (fairly light) and 14 (somewhat hard to hard).
- Duration of exercise. Initially, multiple 10-minute bouts distributed throughout the day may be optimal for some patients. During the first 2-6 weeks of participation, exercise duration should be gradually increased from 30 minutes to 45 minutes or more. (This does not include the warm-up, cool down, or stretching periods crucial to any workout.) Duration should be increased to 20-30 minutes before intensity is increased. A steady rate of perceived exertion should be maintained by increasing activity as tolerated.
- Frequency of exercise. From the onset, exercise frequency should be 3-5 times per week.

Evidence supporting this recommendation is of classes: A, M, R

## 63. Short-Term Follow-Up: Chronic Adjunctive Medication/Outpatient Management

### Chronic Adjunctive Medications

Use of enteric-coated ASA or ASA plus clopidogrel should be continued. Use of beta-blockers following MI has been shown to reduce ischemia, prevent arrhythmias and reinfarction, and improve survival. Patients with large anterior infarctions may benefit from therapeutic warfarin therapy (INR 2-3), usually for 3 months to reduce risk of systemic emboli. ACE inhibitors provide long-term cardiac protection for patients (with or without symptoms) with left ventricular ejection fraction (EF) of less than 40%.

Most patients should be receiving a statin or alternative lipid-lowering medication at discharge from the hospital. Lipid-lowering therapy should be considered for patients who have undergone PCI or CABG and patients whose low-density lipoprotein cholesterol level is 100 mg/dL or greater. Calcium channel blockers should be considered only for patients with NSTEMI who cannot take beta-blockers, and patients without CHF or decreased LV ejection fraction. Oral nitrates should be considered for patients with ongoing ischemia.

### Follow-Up Visits

Usually, patients should return for a follow-up visit with their cardiologist or primary care physician within 2-3 weeks so the physician can monitor progress, answer questions, and consider further risk stratification (i.e., stress testing). Risk factor modification should be continued.

### Phase 4 Cardiac Rehabilitation

Phase 4 cardiac rehabilitation begins after the desired functional capacity has been attained (usually greater than or equal to 8 METs) and/or  $\text{VO}_2\text{max}$  has reached a plateau. Maintenance is the principal goal. The exercise prescription should continue as at the end of phase 3 unless angina or exercise intolerance develops, either of which requires cessation of exercise and urgent medical attention. Refer to METs table in Annotation Appendix D and Borg Exertion Scale in Annotation Appendix E of the original guideline document for guidance on setting exercise goals.

## [AMI Complications Algorithm Annotations](#)

### 65. Arrhythmic Complication(s)?

Arrhythmic complications including sinus bradycardia, Möbitz I (Wenkebach) or II block, premature ventricular contractions (PVCs), accelerated idioventricular rhythm, and supraventricular arrhythmias (atrial flutter, atrial fibrillation, supraventricular tachycardia) are generally benign and will usually require no special therapy.

Five Centers for Medicare and Medicaid Services (CMS) covered indications for defibrillators

1. Documented episode of cardiac arrest due to ventricular fibrillation (VF), not due to transient or reversible cause.
2. Documented sustained ventricular tachycardia (VT) either spontaneous or induced by an electrophysiologic (EP) study, not associated with an acute MI and not due to transient or reversible cause.
3. Documented familial or inherited conditions with a high risk of life threatening VT such as long QT syndrome or hypertrophic cardiomyopathy.
4. Coronary artery disease with documented prior MI, ejection fraction (EF) less than 35%, an inducible sustained VT or VT at EP study.
5. Documented prior MI, EF = 30%, QRS duration of greater than 120 msec (patient must not have Class IV heart failure, shock, CABG, PCI, MI within 3 months or a need for coronary revascularization or predicted survival less than 1 year).

#### 66. Treat Arrhythmic Complication(s)

ACLS guidelines provide in-depth descriptions of short-term treatment.

Evidence supporting this recommendation is of classes: B, C

#### 67. Ischemic Complication(s)?

Ischemic complications include postinfarction angina.

#### 68. Treat Ischemic Complication(s)

Treatment of postinfarction angina should be correlated with ECG changes, if possible. Optimal therapy consists of beta-blockers and long-acting nitrates. If beta-blockers are not tolerated or are ineffective and LV function is not significantly depressed, a calcium channel blocker may be used. Early coronary angiography should be considered. Angina after MI may be confused with pericarditis. Aneurysm formation should be a consideration.

#### 69. Mechanical Complication(s)?

Mechanical complications may include papillary muscle dysfunction or rupture with significant mitral regurgitation, ventricular septal rupture, myocardial rupture, right ventricular infarction, pericarditis with or without tamponade, LV dysfunction, and aneurysm formation.

#### 70. Treat Mechanical Complication(s)

Papillary muscle dysfunction is evidenced by the murmur of mitral regurgitation, typically within 5 days of infarction.

Papillary muscle rupture may occur within 10 days of the event. Findings include development of sudden congestive heart failure (CHF) or pulmonary

edema, often but not always accompanied by a new holosystolic apical murmur. Diagnosis is verified by echocardiography. Stabilization is achieved by one or more of the following: aggressive use of diuretics and vasodilators, insertion of a Swan-Ganz catheter, insertion of an intraaortic balloon pump (IABP). Because of the high mortality rate with this complication, urgent surgical repair is indicated.

Ventricular septal rupture (VSR) occurs within 1 week of infarction and results in left-to-right shunting and subsequent hemodynamic deterioration. VSR is suggested by the presence of a new, harsh, holosystolic murmur that is loudest along the lower left sternal border; this may be accompanied by a thrill. Patients may also have symptoms of right-sided heart failure with right ventricular (RV) PO<sub>2</sub> step-up and may have less pulmonary congestion than patients with papillary muscle rupture. The diagnosis is confirmed by two-dimensional echocardiography. Patients are best stabilized by vasodilator therapy, insertion of a Swan-Ganz catheter or an IABP, or all of these. Because of the high mortality rate, urgent surgical repair is indicated.

Myocardial rupture is a common cause of sudden death after acute MI. Symptoms or findings include emesis, persistent restlessness, anxiety, and persistent ST-wave elevation on ECG. Rupture usually occurs within 5-7 days of MI. LV free-wall rupture leads to hemopericardium and subsequent death from tamponade. Contained rupture may result in formation of a pseudoaneurysm. Surgical resection is recommended.

Right ventricular (RV) infarction is suspected in patients with inferior infarction complicated by low cardiac output, hypotension, oliguria, jugular venous distention, and clear lung fields without radiographic evidence of pulmonary venous congestion. Infarction can be confirmed by ECG findings (ST-segment elevation in right precordial leads V<sub>4</sub>R through V<sub>6</sub>R in the presence of inferior ST elevation), two-dimensional echocardiography or pulmonary artery catheter demonstrating a disproportionate elevation of right atrial pressure compared with pulmonary capillary wedge pressure. Treatment consists of intravascular volume expansion and use of inotropic agents; if the patient loses sinus rhythm, temporary pacing to re-establish AV synchrony should be considered. Agents that reduce RV preload, such as nitroglycerin, diuretics, and large doses of morphine, should be avoided. ACE inhibitors and beta-blockers may require dose reduction or discontinuation with milder presentation of RV dysfunction post-MI.

Post-MI pericarditis can be early (occurring within 72 to 96 hours after acute MI) or occasionally delayed (typically occurring weeks after MI); the latter is called Dressler's Syndrome. Early pericarditis is suspected in patients with pericardial friction rub, usually heard on the second or third day after acute MI, and chest pain that may extend to the back, neck, or shoulders that is intensified by movement and respiration and relieved by sitting up or leaning forward. Treatment consists of anti-inflammatory agents and reassurance. Echocardiography to assess for possible incomplete myocardial rupture should be considered. It is important to emphasize to the patient that the recurrent pain is not the result of recurrent infarction. Risk of hemopericardium is increased in patients receiving anticoagulants; development of a pericardial effusion can be detected by close clinical observation and echocardiography.

Dressler's Syndrome is characterized by an increase in erythrocyte sedimentation rate, leukocytosis, and more frequent pleural and pericardial effusions than in early pericarditis. Because of the increased incidence of pericardial effusion, anticoagulation should be used with caution. Treatment for pericardial effusion with impending tamponade is pericardiocentesis, preferably guided by echocardiography.

Risk of developing LV dysfunction and subsequent heart failure (HF) is greatly increased in patients with more extensive MI. Restricted diastolic filling patterns on echocardiography may predict subsequent clinical HF.

Evidence supporting this recommendation is of classes: A, B, C, D, R

### Special Work-Up Algorithm Annotations

#### 74. Clinical Features Suggest Dissecting or Symptomatic Aneurysm?

- Clinical findings of ischemia involving several organ systems
- Pain typically "tearing" or "ripping"
- Pain radiation from chest to back, hips and lower extremities
- Common findings: hypertension, cardiac murmurs, systolic bruits, diminished or absent pulses
- Chest x-rays (CXR) - abnormalities around aortic knob, increased diameter of ascending aorta
- Blood pressure discrepancy between right and left arm

#### 75. Diagnosis of Dissection, Immediate Computed Tomography (CT) Angiogram or Echo/Transesophageal Echocardiography (TEE); Magnetic Resonance Imaging (MRI) if Clinically Stable and Patient Asymptomatic

- CT angiogram is generally the quickest and most readily available diagnostic test.
- TEE with a biplane probe is equally diagnostic and preferable in patients with renal insufficiency or allergy to contrast dye.
- MRI remains the most accurate test, but requires a stable patient. MRI should be avoided if a type A dissection is suspected.

Evidence supporting this recommendation is of classes: C, R

#### 76. Test Diagnostic of Type A Dissection or Symptomatic Aneurysm?

The imaging procedure should establish the presence or absence of an aneurysm and the presence or absence, and location, of a dissection.

#### 77. Arrange for Immediate Cardiovascular Surgery Consultation/Nitroprusside + Esmolol Drip

- Surgical intervention for symptomatic thoracic aneurysms and proximal (type A; ascending aorta) dissections
- Control blood pressure (BP) with nitroprusside or esmolol drip

Evidence supporting this recommendation is of class: R

#### 78. Treatment of Distal Dissection

- Distal (type B; distal to left subclavian artery) aortic dissections generally appropriate for pharmacologic therapy
  - Nitroprusside or esmolol drip to control BP and heart rate (eliminate pain and stabilize dissection)
- Consider surgery if therapy not effective

#### 79. Symptoms, ABGs (Arterial Blood Gases), CXR (Chest X-Ray) Suggest Pulmonary Embolus?

- Symptoms may include dyspnea, tachypnea, pleuritic chest pain
- Physical findings extremely variable, may include fever, wheezing
- ECG - non-specific ST-T changes
- CXR - normal, pleural effusion, wedge-shaped infiltrate
- ABG - abnormal A-a gradient

#### 81. Symptoms, ABGs, CXR Suggest Pneumothorax?

- Idiopathic or spontaneous pneumothorax - sudden onset of pleuritic chest pain and dyspnea (pleuritic pain more prominent with small pneumothorax, dyspnea with large)
- ABGs may be abnormal

#### Consider Chest Tube and Hospitalization

- Pneumothorax greater than 10-20% usually require chest tube
- Outpatient treatment possible if progression unlikely and patient reliable
  - Catheter aspiration followed by several hours of observation
  - Indwelling catheter attached to Heimlich valve
- Inpatient treatment if pneumothorax is secondary or significant symptoms
- Reabsorption slow - 1.25% per day

#### 83. Symptoms, Signs Suggest Pericardial Disease?

- Chest pain worsened with inspiration, coughing, position changes or swallowing
- Pericardial friction rub
- ECG - ST-T changes
- Etiology - infectious, neoplastic, metabolic, inflammatory autoimmune disorders, post MI (Dressler's syndrome)
- Drug related - hydralazine, procainamide, isoniazid, phenytoin, doxorubicin
- Consider blunt trauma, post-op

#### 84. Tamponade?

- Chest pressure and shortness of breath
- Exam - elevated jugular venous pressure, hypotension, tachypnea, narrow pulse pressure, pulsus paradoxus greater than 20 mm/Hg
- ECG may reveal electrical alternans
- CXR - normal or enlarged cardiac silhouette
- Echocardiogram diagnostic test of choice

#### 85. Pericardiocentesis - Prefer Echocardiography (ECHO) Directed

- Echo-directed apical pericardiocentesis procedure of choice
- Subxyphoid approach if echo not available and patient unstable

#### 86. Admit to CCU/ICU

The patient should be observed in an ICU/CCU setting.

#### 87. Echo; Discharge?/Consider Treatment

- Pericarditis without tamponade – obtain echocardiogram
- Nonsteroidal anti-inflammatory drugs (NSAIDs) or ASA and close follow-up for viral or idiopathic

### Non-Cardiac Causes Algorithm Annotations

#### 89. Symptoms, Signs, CXR Suggest Pleural or Parenchymal Pulmonary Disease?

Patients with pulmonary or pleural disease frequently have a presenting complaint of chest pain with or without shortness of breath. A detailed history, physical examination, ECG, chest x-ray and laboratory evaluation typically will often suggest the diagnosis. Differential diagnoses include chronic obstructive pulmonary disease (COPD), asthma, infectious processes, and malignancies. Specific management of these diagnoses is beyond the scope of this guideline.

#### 90. Evaluate for Observation or Admission

Disposition decisions are largely dependent on the patient's stability. The initial treatment must be directed toward treating any instability and searching for the etiology of the symptoms. Pulse, blood pressure, respirations and level of consciousness must be assessed. Other factors that need to be considered are age, general state of health and immuno-competency and reliability. If a patient is labile or unstable, or at risk of becoming unstable, admit the patient.

#### 91. Symptoms and Signs Suggest Chest Wall/Costochondritis?

Costochondritis and intercostal strain frequently presents with chest pain. Typically, the patient is able to localize the discomfort to a fairly limited area. Physical examination should reveal reproducible pain at the site of the discomfort.

#### 92. NSAIDs/Thermal Application/Follow-Up PRN

Once the clinician has determined that the chest discomfort is limited to the chest wall, treatment with nonsteroidal anti-inflammatory medication should be started and the patient should be advised on local application. Follow-up may be arranged as needed. For expanded discussion, refer to the National Guideline Clearinghouse (NGC) summary of the Institute for Clinical Systems Improvement (ICSI) guideline [Assessment and Management of Acute Pain](#).

Evidence supporting this recommendation is of classes: C, R

#### 93. Consider Gastrointestinal (GI) Diagnosis?

GI disorders are sometimes perceived by the patient as chest pain. Once the clinician is confident that no intra-thoracic processes are the cause of the discomfort, a GI diagnosis should be considered.

#### 94. Gastrointestinal Evaluation

Commonly history, physical examination, and a laboratory evaluation will suggest a GI diagnosis. Further evaluation of this is beyond the scope of this guideline.

#### 95. Reconsider Differential Diagnosis

If the clinician, after initial evaluation and work-up, does not arrive at a likely working diagnosis, he/she may have to go back and reconsider the entire differential diagnosis a second time in order to make certain that no serious condition has been missed. The clinician may then have to redirect his/her search for a diagnosis to conditions of the thoracic spine and thoracic nerves. Other considerations are somatization and anxiety disorders. These may be more or less obvious after careful consideration. For anxiety diagnoses, refer to the NGC summary of the ICSI guideline [Major Depression in Adults in Primary Care](#).

### Clinic Evaluation Algorithm Annotations

#### 97. Initial Focused Assessment for High-Risk History, Physical Exam, and Other Findings

History should include characterization of pain, exacerbating or relieving factors, associated symptoms and risk factors for coronary disease. Physical exam should include careful cardiovascular and pulmonary exam, peripheral vascular exam, and evaluation for hypertension and hypercholesterolemia. Lab studies may include resting ECG, chest x-ray, hemoglobin, and others if clinically indicated.

The patient's description of pain and the history of previous coronary disease are by far the most important parts of the history.

Carotid bruits, peripheral vascular disease, and xanthomas on physical exam suggest a higher likelihood of coronary disease. The resting ECG may show evidence of previous infarction.

Direct provider education toward completing the history evaluation.

Evidence supporting this recommendation is of class: C

High-risk symptoms on initial presentation include:



### History

- Severe or ongoing pain
- Pain lasting 20 minutes or more
- New pain at rest or with minimal activity
- Severe dyspnea
- Loss of consciousness

### Physical Findings

- Hypotension or other signs of under-perfusion
- Tachycardia or bradycardia
- Pulmonary edema, cyanosis

### ECG Findings

- ST elevation greater than 1 mm on two contiguous leads suggesting acute MI
- New ST or T wave changes
- ST depression greater than 1 mm at rest
- New LBBB

## 99. Initiate Emergency Interventions and Transfer to ED as Appropriate

Initiate emergency intervention as appropriate and transfer the patient as soon as possible for further emergency intervention.

A patient complaining of chest pain should immediately be placed on a cardiac monitor. Vital signs should be taken, IV started, oxygen administered, and immediate ECG taken. Institution of stabilizing therapy (including NTG and chewable aspirin for suspect anginal pain) prior to the completion of the history or physical is appropriate and often necessary at this level.

## 100. CAD Diagnosis Secure?

When the clinical setting and history suggest typical angina pectoris (substernal pain provoked by exertion and relieved by nitroglycerin or rest), the physician is very likely correct in assuming an ischemic coronary syndrome. Treatment and prognostic evaluation may proceed as outlined in NGC summary of the ICSI guideline [Stable Coronary Artery Disease](#).

## 101. Refer to the NGC summary of the ICSI guideline [Stable Coronary Artery Disease](#)

Typical angina pectoris, if stable for 60 days and without evidence of recent myocardial infarction, may be treated under in the NGC summary of the ICSI guideline [Stable Coronary Artery Disease](#).

## 102. Ischemic Heart Pain Possible?

When coronary disease is of intermediate probability, a stress test may contribute supplemental information. When coronary disease is unlikely based on highly atypical symptoms and low prevalence of coronary disease among the population to which the patient belongs, stress testing may be misleading.

103. Choose Stress Test/Cardiology Referral Optional

Choose the best type of cardiac stress test based on:

- The resting cardiogram
- The patient's ability to walk
- Local expertise

104. Can Patient Walk?

In patients who cannot exercise consider pharmacologic stress and imaging test (with adenosine, dipyridamole, or dobutamine).

106. Resting ECG Interpretable?

Marked resting ECG abnormalities such as LBBB, LVH with repolarization abnormality, ventricular preexcitation, or ventricular paced rhythm render the exercise ECG uninterpretable for ischemic changes. Patients on digoxin and those with less than 1 mm resting ST depression may undergo standard ECG stress testing, provided the clinician realizes that further ST depression with exercise has minimal diagnostic significance. A stable abnormality with exercise is reassuring.

Evidence supporting this recommendation is of classes: C, R

107. Do Exercise Imaging Study

When the resting ECG is markedly abnormal, use an exercise imaging test (stress echo, stress radionuclear perfusion, stress radionuclear ventriculogram).

108. Do Regular Treadmill Stress Test

Use the Bruce protocol, modified if need be for debilitated patients. Adequacy of exercise and myocardial challenge is generally accepted as achieving greater than or equal to 85% of age-predicted maximum heart rate.

109. Is Test Strongly Positive?

Stress testing may be strongly positive and suggest a moderate to high risk of cardiovascular events as indicated by the Duke treadmill score, which is based upon the Bruce protocol.

A stress test predicts the patient's prognosis and provides evidence of the presence or absence of CAD. Of these two types of information, the first, establishing the patient's prognosis, is the more reliable.

Treadmill findings which signify a poor prognosis are:

- Poor exercise tolerance
- Hypotension
- Marked ST abnormality at a low work load

Conversely, good exercise tolerance to a high heart rate and blood pressure signifies a good prognosis, even if the exercise ECG is somewhat abnormal. (For example, a patient who walks 9 minutes and has 1 mm of asymptomatic ST depression.)

Mark et al (Duke treadmill score) validated an easy-to-use treadmill score which stratifies high-, intermediate-, and low-risk patients. Refer to the NGC summary of the ICSI [Cardiac Stress Test Supplement](#) for scoring methods and application.

A Duke score of greater than or equal to 5 is generally accepted as a passing score, and such patients may be discharged to home with follow-up within 72 hours.

Evidence supporting this recommendation is of classes: A, B, C, R

Refer to Annotation Appendix E, "Nomogram of the Prognostic Relations Embodied in the Treadmill Score" in the original guideline document.

110. Is Patient a Candidate for Revascularization?

Unless advanced age, co-morbidity, or patient preference suggests medical treatment, high-risk patients should be considered for revascularization.

Evidence supporting this recommendation is of classes: A, C

113. Is Test Positive but Low Risk?

A stress cardiogram may be positive but without features which signify a poor prognosis as noted above. For example, a 65-year-old man with atypical angina and 1.0 mm ST depression at 10 minutes has a good prognosis even though he has coronary disease.

114. Is Diagnostic Certainty Adequate?

A positive test may confirm the clinical diagnosis of coronary disease and allow treatment as outlined under the NGC summary of the ICSI guideline [Stable Coronary Artery Disease](#).

Refer to cardiology if diagnostic certainty is critical.

Evidence supporting this recommendation is of classes: C, M

117. Is Test Equivocal?

Because of resting abnormality, limited exercise performance, limited heart rate, or minor exercise abnormalities, the test may not be clearly normal or abnormal, yet high-risk treadmill findings are absent.

Evidence supporting this recommendation is of classes: C, M

118. Is Diagnostic Certainty Adequate?

Knowing that the patient is not at high risk may suggest empiric treatment or non-cardiac evaluation. Refer to cardiology if diagnostic certainty is important.

Evidence supporting this recommendation is of classes: C, M

121. Test is Normal

A normal test may confirm the clinical impression of non-cardiac symptoms. Refer to cardiology if symptoms are worrisome despite a normal stress test.

Definitions:

Classes of Research Reports:

A. Primary Reports of New Data Collection:

Class A:

- Randomized, controlled trial

Class B:

- Cohort study

Class C:

- Nonrandomized trial with concurrent or historical controls
- Case-control study
- Study of sensitivity and specificity of a diagnostic test
- Population-based descriptive study

Class D:

- Cross-sectional study
- Case series
- Case report

B. Reports that Synthesize or Reflect upon Collections of Primary Reports:

Class M:

- Meta-analysis

- Systematic review
- Decision analysis
- Cost-effectiveness analysis

Class R:

- Consensus statement
- Consensus report
- Narrative review

Class X:

- Medical opinion

## CLINICAL ALGORITHM(S)

Detailed and annotated clinical algorithms are provided for:

- [Chest Pain Screening](#)
- [Emergency Intervention](#)
- [ST-Segment Elevation Myocardial Infarction \(STEMI\)](#)
- [Acute Myocardial Infarction \(AMI\) Complications](#)
- [Special Work-Up](#)
- [Non-Cardiac Causes](#)
- [Clinic Evaluation](#)

## EVIDENCE SUPPORTING THE RECOMMENDATIONS

### TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The guideline contains an annotated bibliography and discussion of the evidence supporting each recommendation. The type of supporting evidence is classified for selected recommendations (see "Major Recommendations").

## BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

### POTENTIAL BENEFITS

- Successful emergency interventions in patients with high-risk chest pain
- Improved diagnostic value of stressed tests through their appropriate use in patients with chest pain symptoms
- Minimized delay in administering thrombolytics or angioplasty in patients with acute myocardial infarction (AMI)
- Timely initiation of treatment to reduce post-infarction mortality in patients with AMI
- Increased use of risk stratifying procedures in patients with AMI
- Appropriate use of cardiac rehabilitation post-discharge

### POTENTIAL HARMS

## Adverse Effects of Medications and Precautions

- The recently completed SYNERGY study found increased adverse events in patients that were switched from unfractionated heparin to low-molecular weight heparin or vice-versa at the time of referral to tertiary care institutions. Therefore, the suggestion is that the patient be started and maintained on one drug or the other during transfer and treatment at referring and referral institutions.
- Low-molecular weight heparin (LMWH) should be used with caution in patients with renal insufficiency.
- Beta-blockers should be used cautiously in patients with history of asthma, severe left ventricular dysfunction, hypotension, sinus bradycardia, heart block, or cardiogenic shock.
- Calcium channel blockers should be avoided in patients with decreased left ventricular (LV) function or heart failure. The short-acting dihydropyridine calcium channel blockers (e.g., nifedipine) may be associated with increased risk and should be avoided in acute ischemic syndromes.
- Low patient weight has been identified as an ongoing risk factor for significant intracranial hemorrhage when thrombolytics are administered

## CONTRAINDICATIONS

### CONTRAINDICATIONS

#### Contraindications to IIb-IIIa Inhibitors

- Bleeding less than 6 weeks
- Intracranial hemorrhage (ever)
- Recent stroke less than 2 years
- Uncontrolled hypertension greater than 200/100 mmHg
- Surgery less than 6 weeks
- Aortic dissection
- Acute pericarditis
- Platelets less than 100,000 mm<sup>3</sup>
- Dialysis dependent renal failure

#### Contraindications to Nitroglycerin

- Hypotension
- Documented severe aortic stenosis
- Hypertrophic cardiomyopathy
- Sildenafil, vardenafil, orildenafil within the previous 24 hours or tadalafil in the previous 48 hours

#### Contraindications to Thrombolytics\*

##### Absolute Contraindications

- Previous hemorrhagic stroke at any time; other strokes or cerebrovascular events within one year
- Known intracranial neoplasm

- Active internal bleeding (does not include menses)
- Suspected aortic dissection

#### Cautions/Relative Contraindications

- Severe uncontrolled hypertension on presentation (greater than 180/110 mm Hg)\*\*
- History of prior cerebrovascular accident or known intracerebral pathology not covered in above absolute contraindications
- Current use of anticoagulants in therapeutic doses (international normalized ratio [INR] greater than or equal to 2.0-3.0); known bleeding diathesis
- Recent trauma (including head trauma) within 2-4 weeks
- Major surgery in past 3-6 months
- Noncompressible vascular punctures
- Recent internal bleeding
- For streptokinase/anistreplase: prior exposure (especially within 5 days to 2 years) or prior allergic reaction
- Pregnancy
- Active peptic ulcer
- History of chronic hypertension

\* Advisory only. May not be all inclusive or definitive. Patients with relative contraindications should be evaluated on a case-by-case basis. Percutaneous coronary intervention (PCI) may provide equal or increased benefit at decreased risk.

\*\*Severe uncontrolled hypertension on presentation is a relative contraindication. Even if hypertension is brought under control, patients subsequently treated with thrombolytics experience increased rates of ICH compared to patients who are normotensive on presentation. Arrange for primary PCI in high-risk.

NOTE: Cardiopulmonary resuscitation performed for less than 10 minutes is NOT a contraindication.

## QUALIFYING STATEMENTS

### QUALIFYING STATEMENTS

- These clinical guidelines are designed to assist clinicians by providing an analytical framework for the evaluation and treatment of patients, and are not intended either to replace a clinician's judgment or to establish a protocol for all patients with a particular condition. A guideline will rarely establish the only approach to a problem.
- This medical guideline should not be construed as medical advice or medical opinion related to any specific facts or circumstances. Patients are urged to consult a health care professional regarding their own situation and any specific medical questions they may have.

## IMPLEMENTATION OF THE GUIDELINE

### DESCRIPTION OF IMPLEMENTATION STRATEGY

Once a guideline is approved for general implementation, a medical group can choose to concentrate on the implementation of that guideline. When four or more

groups choose the same guideline to implement and they wish to collaborate with others, they may form an action group.

In the action group, each medical group sets specific goals they plan to achieve in improving patient care based on the particular guideline(s). Each medical group shares its experiences and supporting measurement results within the action group. This sharing facilitates a collaborative learning environment. Action group learnings are also documented and shared with interested medical groups within the collaborative.

Currently, action groups may focus on one guideline or a set of guidelines such as hypertension, lipid treatment, and tobacco cessation.

Detailed measurement strategies are presented to help close the gap between clinical practice and the guideline recommendations. Summaries of the measures are provided in the National Quality Measures Clearinghouse (NQMC).

Hospitals and clinics are strongly encouraged to consider the following when implementing systems to support best care of patients with acute coronary syndromes:

1. Clinics should have a process in place for a patient to be referred for emergency intervention via 911, or be seen in the clinic the same day, within 72 hours, or as an elective clinic evaluation based upon the presence of high-risk symptoms and duration.
2. Hospitals should develop and implement Emergency Department (ED) critical pathways and consider standard orders to accomplish rapid evaluation and treatment of acute coronary syndrome. Standard discharge orders/instructions should also be considered.
3. A process should be in place for the patient and family that will rapidly orient them to the suspected diagnosis, ED and Critical Care Unit (CCU) process and other treatment measures to be considered. This could include both caregiver face-to-face interactions with the patient and family as well as teaching tools in written form.
4. Institutions that cannot meet the recommended treatment times for primary percutaneous coronary intervention (PCI) should consider the preferential use of intravenous thrombolytics therapy. These institutions should have a predetermined plan for treating patients who present with contraindications to thrombolytics. Such plans may employ delayed local primary PCI or transfer to another institution.

## IMPLEMENTATION TOOLS

Clinical Algorithm  
Pocket Guide/Reference Cards  
Quality Measures

For information about [availability](#), see the "Availability of Companion Documents" and "Patient Resources" fields below.

## RELATED NQMC MEASURES



- [Diagnosis and treatment of chest pain and acute coronary syndrome \(ACS\): percentage of patients with chest pain symptoms in emergency department \(ED\) receiving early therapy including intravenous \(IV\) access, oxygen and a chewable aspirin on arrival.](#)
- [Diagnosis and treatment of chest pain and acute coronary syndrome \(ACS\): percentage of patients with chest pain symptoms having stress tests with the Duke score present.](#)
- [Diagnosis and treatment of chest pain and acute coronary syndrome \(ACS\): percentage of patients with acute myocardial infarction \(AMI\) receiving thrombolytics with a "door-to-drug time" \(time from presentation to administration of drug\) of less than 30 minutes.](#)
- [Diagnosis and treatment of chest pain and acute coronary syndrome \(ACS\): percentage of patients with acute myocardial infarction \(AMI\) receiving beta-blockers no later than discharge.](#)
- [Diagnosis and treatment of chest pain and acute coronary syndrome \(ACS\): percentage of patients with acute myocardial infarction \(AMI\) receiving or scheduled for a risk stratifying procedure prior to discharge.](#)

## INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

### IOM CARE NEED

Getting Better

### IOM DOMAIN

Effectiveness  
Timeliness

## IDENTIFYING INFORMATION AND AVAILABILITY

### BIBLIOGRAPHIC SOURCE(S)

Institute for Clinical Systems Improvement (ICSI). Diagnosis and treatment of chest pain and acute coronary syndrome (ACS). Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2004 Nov. 79 p. [144 references]

### ADAPTATION

Not applicable: The guideline was not adapted from another source.

### DATE RELEASED

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### GUIDELINE DEVELOPER(S)

Institute for Clinical Systems Improvement - Private Nonprofit Organization

## GUIDELINE DEVELOPER COMMENT

Organizations participating in the Institute for Clinical Systems Improvement (ICSI): Affiliated Community Medical Centers, Allina Medical Clinic, Altru Health System, Aspen Medical Group, Avera Health, CentraCare, Columbia Park Medical Group, Community-University Health Care Center, Dakota Clinic, ENT Specialty Care, Fairview Health Services, Family HealthServices Minnesota, Family Practice Medical Center, Gateway Family Health Clinic, Gillette Children's Specialty Healthcare, Grand Itasca Clinic and Hospital, HealthEast Care System, HealthPartners Central Minnesota Clinics, HealthPartners Medical Group and Clinics, Hutchinson Area Health Care, Hutchinson Medical Center, Lakeview Clinic, Mayo Clinic, Mercy Hospital and Health Care Center, MeritCare, Mille Lacs Health System, Minnesota Gastroenterology, Montevideo Clinic, North Clinic, North Memorial Care System, North Suburban Family Physicians, Northwest Family Physicians, Olmsted Medical Center, Park Nicollet Health Services, Pilot City Health Center, Quello Clinic, Ridgeview Medical Center, River Falls Medical Clinic, Saint Mary's/Duluth Clinic Health System, St. Paul Heart Clinic, Sioux Valley Hospitals and Health System, Southside Community Health Services, Stillwater Medical Group, SuperiorHealth Medical Group, University of Minnesota Physicians, Winona Clinic, Ltd., Winona Health

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## GUIDELINE COMMITTEE

Cardiovascular Steering Committee

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## FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

In the interest of full disclosure, institute for Clinical Systems Improvement (ICSI) has adopted the policy of revealing relationships work group members have with companies that sell products or services that are relevant to this guideline topic. The reader should not assume that these financial interests will have an adverse impact on the content of the guideline. Readers of the guideline may assume that only work group members listed below have potential conflicts of interest to disclose.

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## GUIDELINE STATUS

This is the current release of the guideline.

## GUIDELINE AVAILABILITY

Electronic copies: Available from the [Institute for Clinical Systems Improvement \(ICSI\) Web site](http://www.icsi.org).

Print copies: Available from ICSI, 8009 34th Avenue South, Suite 1200, Bloomington, MN 55425; telephone, (952) 814-7060; fax, (952) 858-9675; Web site: [www.icsi.org](http://www.icsi.org); e-mail: [icsi.info@icsi.org](mailto:icsi.info@icsi.org).

## AVAILABILITY OF COMPANION DOCUMENTS

The following is available:

- ICSI pocket guidelines. April 2004 edition. Bloomington (MN): Institute for Clinical Systems Improvement, 2004. 404 p.

Print copies: Available from ICSI, 8009 34th Avenue South, Suite 1200, Bloomington, MN 55425; telephone, (952) 814-7060; fax, (952) 858-9675; Web site: [www.icsi.org](http://www.icsi.org); e-mail: [icsi.info@icsi.org](mailto:icsi.info@icsi.org).

## PATIENT RESOURCES

None available

## NGC STATUS

This NGC summary was completed by ECRI on February 16, 2005. This summary was most recently updated on May 3, 2005 following the withdrawal of Bextra (valdecoxib) from the market and the release of heightened warnings for Celebrex (celecoxib) and other nonselective nonsteroidal anti-inflammatory drugs (NSAIDs).

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